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# Binaries, Planets, and Pluto, Oh my!

Lessons and stories from a NMHS grad-turned-astronomer

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Metropolis Postdoctoral Fellow

Los Alamos National Laboratory



Hi! I'm Rachel, and I'm a  
*computational astrophysicist.*



Hi! I'm Rachel, and I'm a  
*computational astrophysicist.*

I use simulations and  
supercomputers to  
do my research

I try to understand  
*how* the universe  
works the way it does

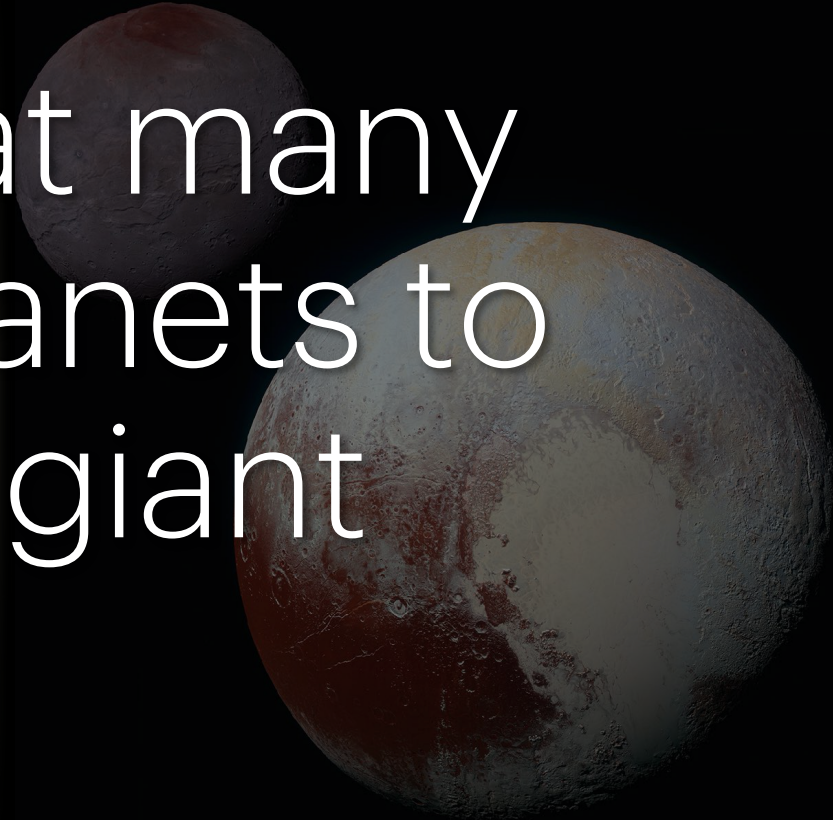
# I really like binaries

*A binary is*

a system of two objects  
of roughly comparable mass  
orbiting a common center

Albireo, a visual binary in  
Cygnus, was one of the first  
binaries I knew about  
Image credit: Tom Wildoner

I've studied binaries at many scales, from dwarf planets to planetary systems to giant molecular clouds

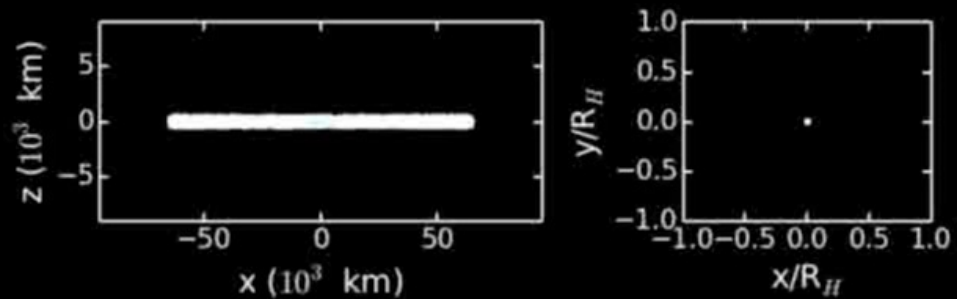
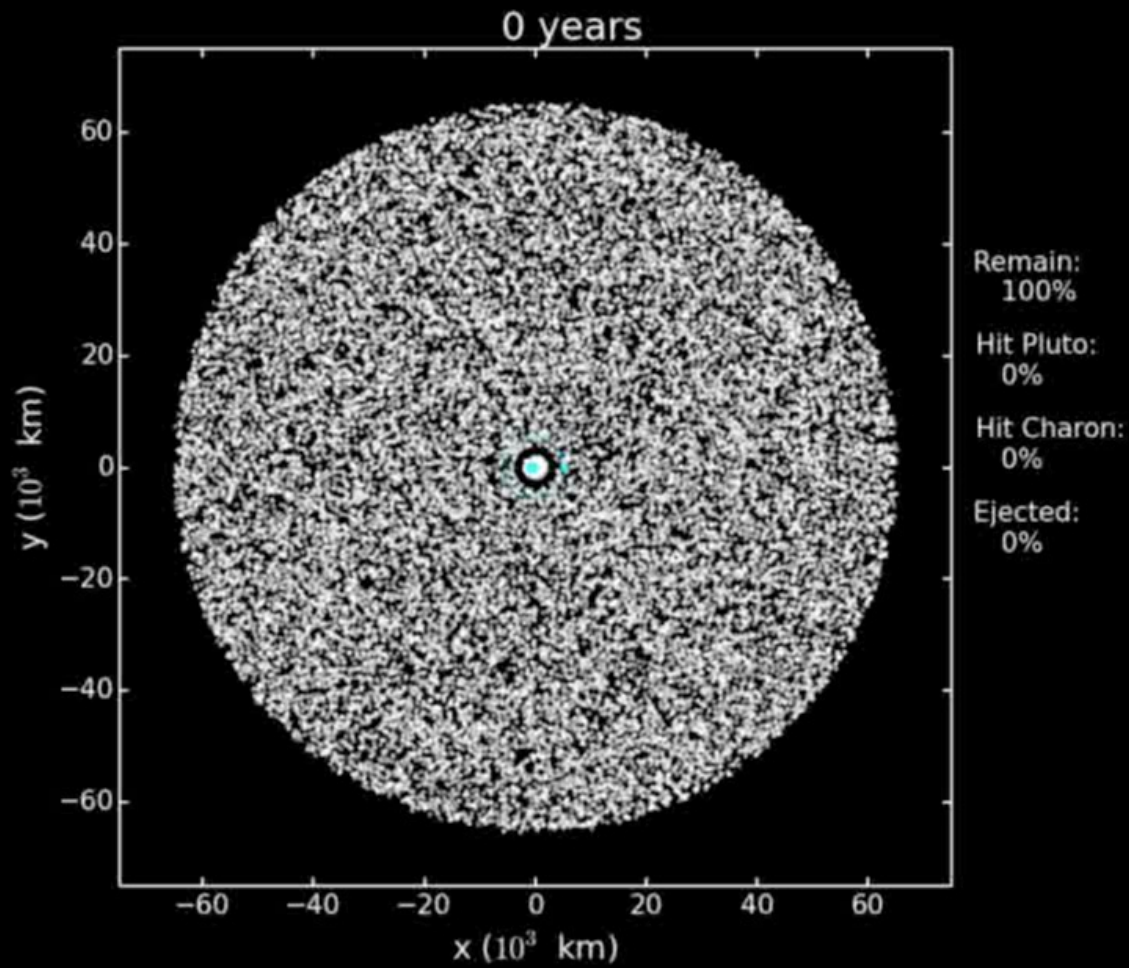


# Pluto-Charon, the best binary dwarf planet!



- Pluto lives in the Kuiper Belt beyond Neptune
- Pluto is actually a binary
- Pluto-Charon has four *circumbinary* moons





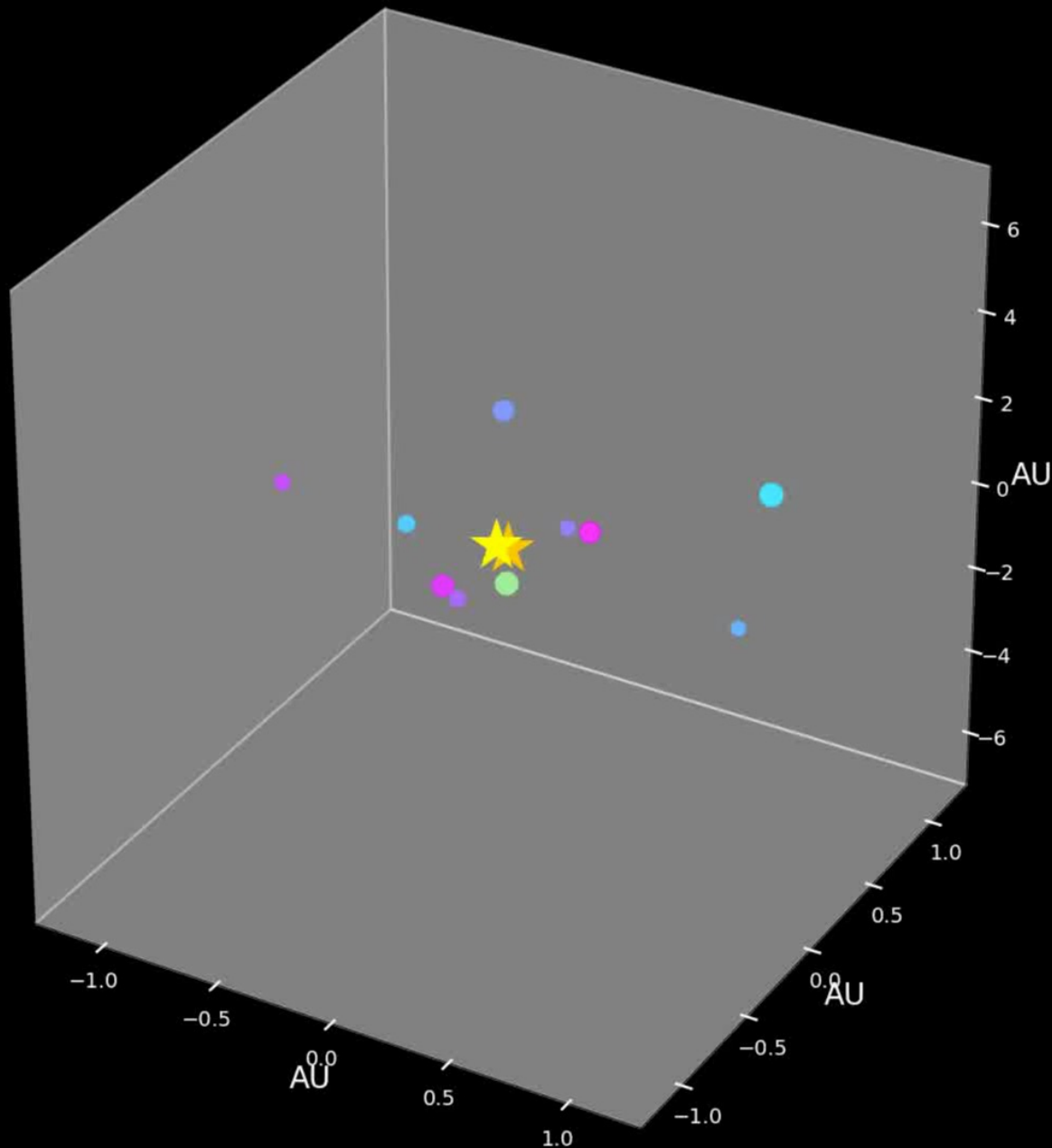
Using simulations,  
I study the debris that  
formed in the giant  
collision that made the  
Pluto-Charon binary

# Circumbinary planets exist!

(And may be more common than you think)



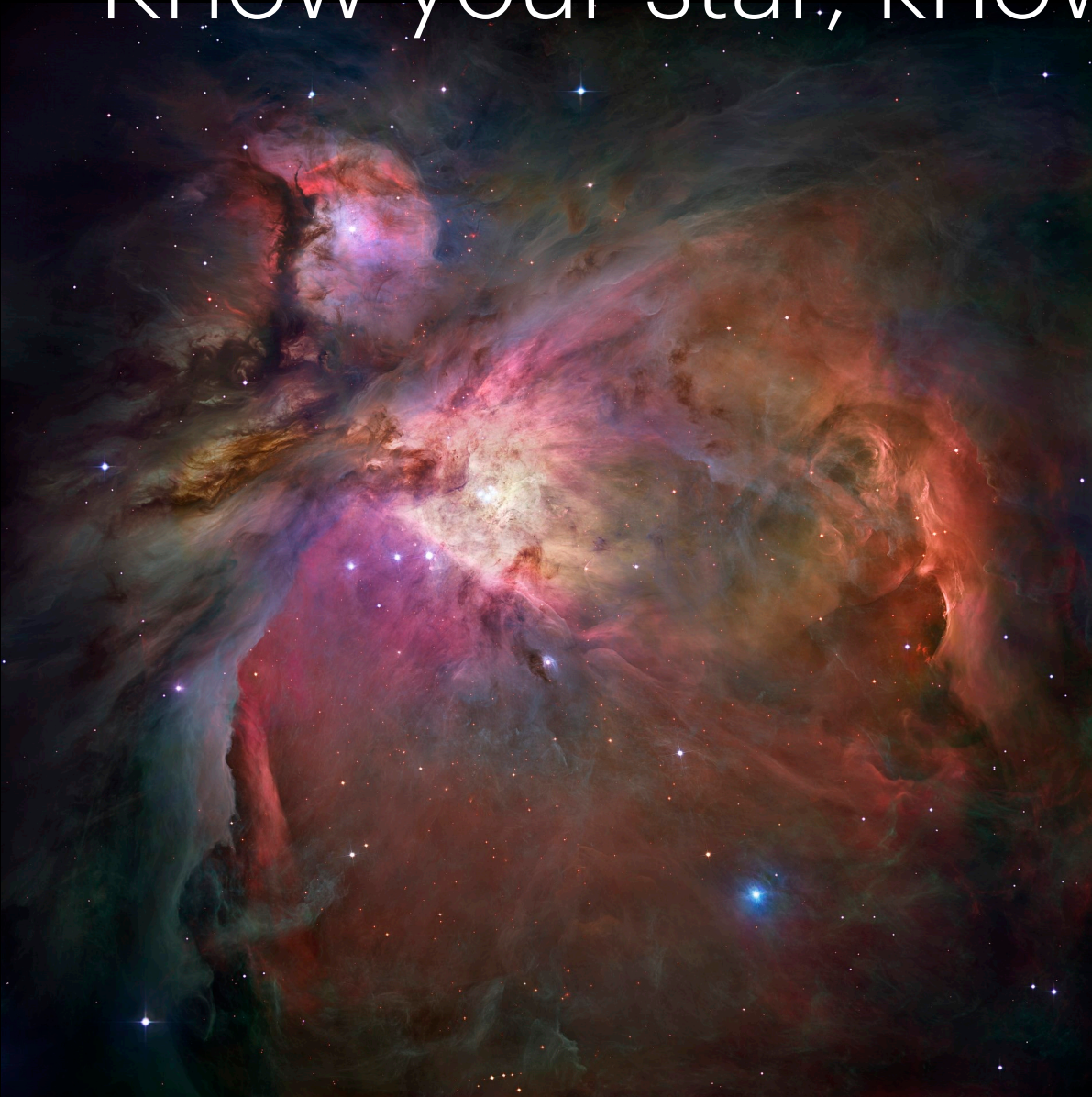
- Tatooine from *Star Wars* is a circumbinary planet
- About half of all stars in the galaxy are in binaries
  - There could be a lot of circumbinary planets out there!



I use my simulations to understand how planetary systems evolve differently around single stars and binary stars

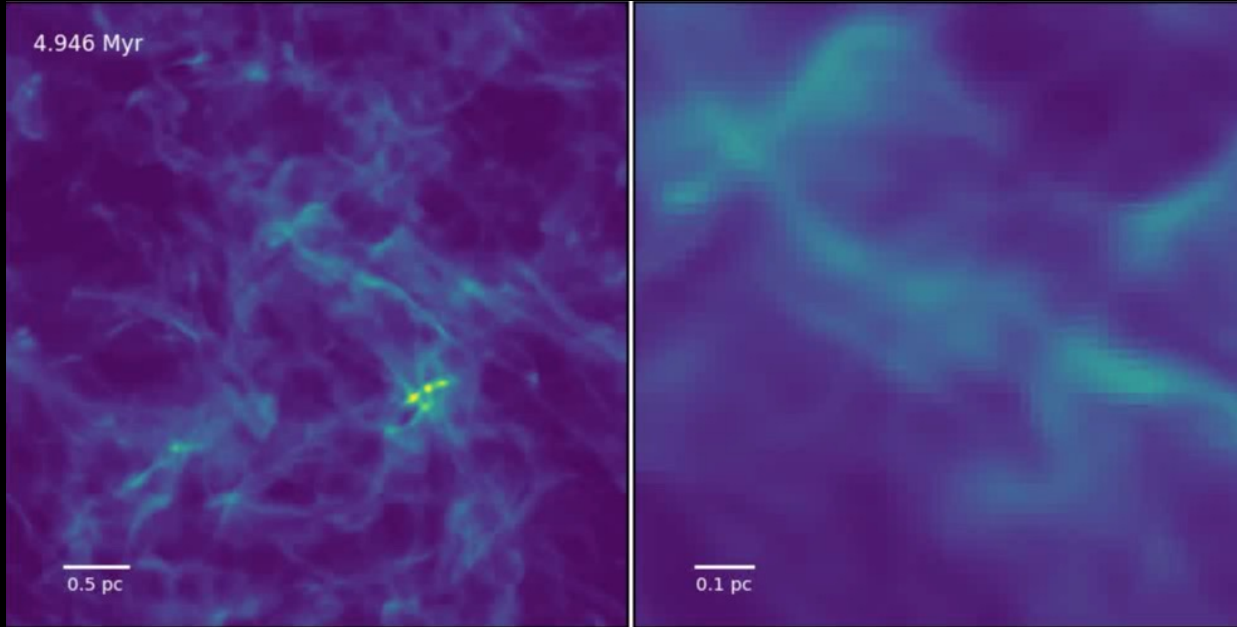
# Know your star, know your... everything

- Stars form in molecular clouds
- If we know how stars form, we can estimate an awful lot about
  - planets,
  - supernova,
  - galaxies,
  - and more

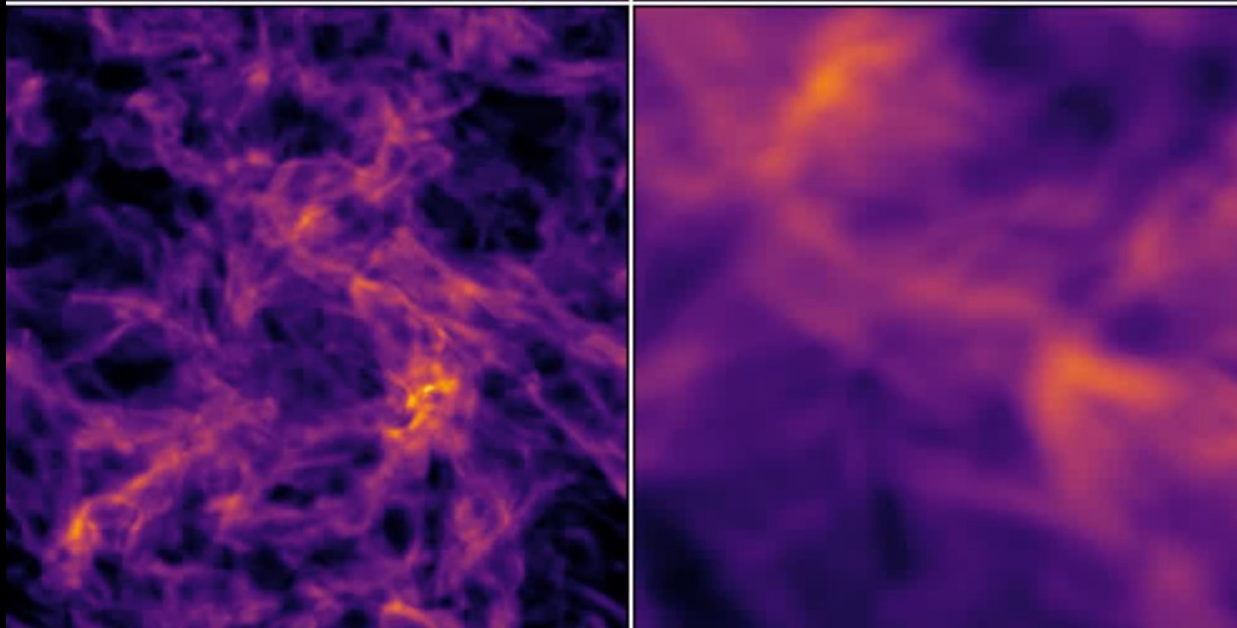




“Real” gas



“Observation”



Star formation is  
messy and  
complicated.

I’m trying to  
understand how the  
real gas and what we  
can observe relate.

So.... how did I get here?

And did I learn anything along the way?

# The younger years



I always liked science, but I didn't really know anything about astronomy until Mr. Black's class junior year

I graduated from NMHS in 2010

ugh, I'm old...

September 2010

University of Wyoming

The beginning of my astronomy career



# The (not so) secrets of my success

1. Don't be afraid to say yes



Chip Kobulnicky

Summer 2011

Really got going in  
undergraduate research  
(on binaries, of course)



# The (not so) secrets of my success

1. Don't be afraid to say yes
2. Find good mentors, and let them help!



2011-2014: Fun stuff at UW  
Research, travel to conferences, planetarium shows, outreach, etc.

Summer 2012

National Radio  
Astronomy Observatory



Summer 2013

Kitt Peak  
National Observatory





# The (not so) secrets of my success

1. Don't be afraid to say yes
2. Find good mentors, and let them help!
3. You don't need to be the best (but it helps to be involved)

May 2014

Graduated from UW with  
BS Physics & BS Astronomy

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Existential Crisis:  
Should I get a PhD?

August 2014

Started graduate school at  
University of Arizona

Switched from observational to  
computational astrophysics

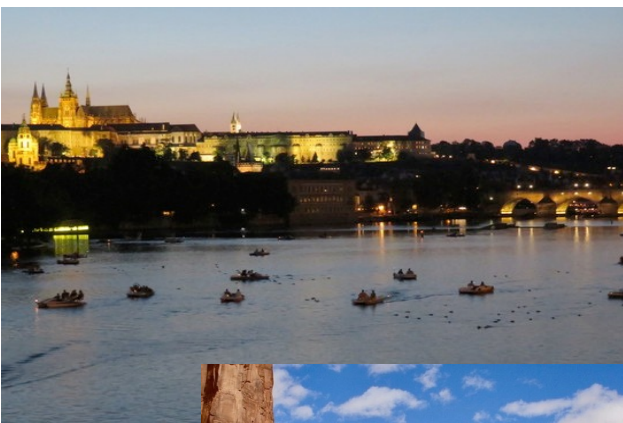


The incredible Kaitlin Kratter  
(remember my #2 secret?)

# The (not so) secrets of my success

1. Don't be afraid to say yes
2. Find good mentors, and let them help!
3. You don't need to be the best (but it helps to be involved)
4. It's okay to change your mind, as long as you gave it your best shot





2014-2020

You already heard the research highlights of that





June 2020

Defended my PhD



(Look, Ma, I'm a doctor now!)

THE FORMATION AND EARLY EVOLUTION OF BINARIES  
AND THEIR ENVIRONMENTS

by  
Rachel Ann Smullen

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A Dissertation Submitted to the Faculty of the  
DEPARTMENT OF ASTRONOMY

In Partial Fulfillment of the Requirements  
For the Degree of

DOCTOR OF PHILOSOPHY  
WITH A MAJOR IN ASTRONOMY AND ASTROPHYSICS

No fun pictures. Sorry!



August 2020-now

Astrophysicist @ Los Alamos  
National Laboratory



# The (not so) secrets of my success

1. Don't be afraid to say yes



Find me at  
[rsmullen.github.io](https://rsmullen.github.io)

2. Find good mentors, and let them help!

3. You don't need to be the best (but it helps to be involved)

4. It's okay to change your mind, as long as you gave it your best shot